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Caltrans Division of Research, Innovation and System Information

Research Results

Enhancing a Freeway Safety Performance Measurement Tool

Intelligent risk analysis software helps Caltrans evaluate and improve freeway safety

Transportation Safety and Mobility

JUNE 2013

Project Title:
Deployment of a Tool for Measuring Freeway Safety Performance

Task Number: 1215
Completion Date: December 31, 2011

This project developed a software tool that superimposes freeway collision data over Transportation Management Center (TMC) maps to display the relative probability of the types of collisions that occur under different traffic conditions.

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WHAT WAS THE NEED?

Freeway safety performance is measured by estimating the cumulative risk of particular collision characteristics. Collision prediction models have the potential to predict the occurrence and severity of collisions by streamlining traffic flow and reducing traffic congestion to improve safety. By incorporating collision prediction models to quantify the safety benefits accrued from smooth and efficient traffic operations, transportation management agencies can better measure urban freeway safety performance.

Still in the early stages of development, not enough research has been conducted to develop and comprehensively assess collision prediction models or to fully understand the benefits that they could bring to an agency's safety and mobility strategies. Traffic collisions have many causes, including roadway geometry, driver behavior, roadway conditions, and vehicle types. And the manner in which safety can be improved on urban freeways by using these models is not yet well understood.

WHAT WAS THE GOAL?

The objective of this study was to develop a tool capable of predicting and assessing the risk of collisions occurring in real time. The safety analysis tool links traffic flow statistical parameters, types of collisions that can occur, varying traffic flow conditions, and the range of circumstances under which collisions occur.

Caltrans improves mobility across California by performing applied research, developing innovations, and implementing solutions.

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WHAT DID WE DO?

A previous research project developed the core methodology of a tool for measuring freeway safety performance. The tool was based on transforming the raw data obtained from pavement loop detectors into 27 distinct variables that together capture the temporal and spatial dynamics of traffic flow. These variables were used to model the relative risk of various kinds of collisions on Orange County's (Caltrans District 12) urban freeways. University researchers updated the original models with more recent collisions and traffic data collected from Orange County freeways, conducted a limited deployment of a safety performance measure tool called Accident Risk Analysis (ARA) used to analyze collision risks, and validated the model predictions against actual collisions for more recent data.

WHAT WAS THE OUTCOME?

The final product is the ARA tool, which links traffic dynamics to factors depicting a roadway's relative safety. With the ARA application, Caltrans can evaluate the safety impacts of roadway changes over time. ARA is capable of predicting even slight increases or decreases in the risk of a collision, taking freeway traffic patterns changes throughout the day into account. By summing up these probabilities over time, an overall picture of the relative safety of the roadway section emerges.

ARA is hosted by the California Traffic Management Laboratories website located at University of California, Irvine. The website provides Time Series Display plots with sufficient data, displaying the daily collision risk performance of all targeted freeway segments in Caltrans District 12.

WHAT IS THE BENEFIT?

ARA allows Caltrans to evaluate the safety impacts of roadway changes over time, evaluating the differences in predicted collision characteristics and numbers before and after significant roadway modifications are implemented. The models indicate when the propensity for collisions inches up or down and why. The predictions are best used to evaluate the cumulative probability of collisions and collision characteristics over longer time horizons and extended stretches of roadway.

The ARA tool is well suited to examine and quantify changes in the relative safety characteristics of an urban freeway section. The methods developed should be adaptable to modeling other phenomena that are dependent on or a result of traffic flow conditions over time. While the estimated models do not perform optimally for toll roads, this is an area for future study.

LEARN MORE

To view the report:
www.dot.ca.gov/research/researchreports/reports/2011/2011-12_task_1215-tsm.pdf

To access the ARA tool, go to:
www.ctmlabs.net
Click on Projects, then Login. First time users will be required to register.

Time Series Display plots, such as this one in Orange County (Caltrans District 12), log the daily collision risk performance of all freeway segments in that district.